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CENTRAL ENGLAND DURING THE NINETEENTH CENTURY: THE BREAK-DOWN OF INDUSTRIAL ISOLATION

By B. C. WALLIS

“Man’s reaction to his environment” defines summarily the subject-matter of the science of geography, and it is the purpose of this paper to demonstrate certain aspects of the reaction which has occurred in a certain area of central England (indicated in Fig. 1). The backbone of England, the Pennine upland, is terminated to the south by the sweep of the valley of the Trent, which rises near the boundary of the county of Cheshire, crosses the counties of Stafford, Derby, and Nottingham, and finally emerges into the Humber. The area under examination includes the southern portion of these Pennine hills, the Trent valley, and the lowlands which fringe the Pennines both to the east and to the west. For convenience of investigation the area is that of the counties of Nottingham, Derby, and Cheshire as well as the northern portion of Staffordshire. This area is not a geographical region, since it includes portions of both eastern and western England; it is not a definite geographical unit, since the variety of its minerals has given rise to various conditions of life. Although it forms a part of the area to which the name “industrial Britain” has been applied, it cannot be regarded as a typically industrial area, since there are many farmers within its boundaries. The district is a connecting link, an area of transition, which lies between the great textile areas of Lancashire and the West Riding of Yorkshire and the great iron area centered upon Birmingham, the “black country.” Such an intermediate area will probably serve better for the purposes of a geographical investigation than a geographical region, or a typically industrial district, since it will continually enforce comparisons between, for example, the effects of coal and salt, or between the lives of farmers and factory hands.

The investigation covers the period of the nineteenth century, since the complete inquiry deals with changes which have occurred within a definite period of time, and since the nineteenth century has many conveniences when considered as a period of change.

The people who inhabit the district are largely native to the area; statistics of migration tend to show that there has been some influx of people from other parts of England but that there has also been a greater outflow from this area both to other parts of England and to other countries, so that it may be concluded that, on the whole, the changes which have occurred within the area are confined to the natives of the district.

The factors in the environment within which these people have lived may be considered under two heads: as static and as dynamic. It should be

remembered, however, that although the static elements, such as relief, climate, and rock-structure, are not constant but cumulative in their effect, yet they may be called static since they are always present, although their relative importance is always changing. The dynamic factors in the environment are due to human activities within the area during previous periods and without the area both during the period under consideration and during earlier years.

STATIC FACTORS IN THE ENVIRONMENT OF THE POPULATION

Relief. The core of the district is that portion of the Southern Pennines which culminates in the Peak, 2088 feet, and which forms the northern portion of Derbyshire, with a minimum elevation of 1000 feet, above which detached portions rise to a height not exceeding 2000 feet (see Fig. 1). Southwards, long narrow valleys, Dovedale and Derwentdale, contain tributaries of the Trent. These valleys are justly famed for their scenery. A projection from the main uplands is continued eastwards to form the low hills of western Nottinghamshire, where the relics of Sherwood Forest make the Dukeries a district whose sylvan beauties attract many tourists. Usually, however, the uplands drop suddenly to the plains which stretch eastwards and westwards at a level lower than 300 feet, yet with a diversity of relief due to valley and knoll which gives considerable variety to the landscape. The eastern plain contains the tributaries of the Trent, and the western, the Cheshire Plain, is diversified by the streams which reach the Weaver, the Dee, and the Mersey. The whole area, therefore, presents the contrast of upland and plain, in which the difference in elevation is greater than that which is encountered elsewhere in England, except farther north.

Rock-Structure. The uplands of northern Derbyshire consist of Carboniferous limestone flanked on the east and northwest by narrow bands of millstone grit: these form the Lower Carboniferous rocks of Figure 2. Almost entirely along the western and quite along the eastern edge of these rocks lie the Coal Measures, and beyond these are the lower heights and the plains, where the rocks are chiefly Keuper marls and sandstones with specimens of Bunter sandstone in western Nottinghamshire and western Cheshire. The Robin Hood Hills of Nottinghamshire are a Bunter formation, but the knolls of Cheshire are Keuper sandstone. The scenic beauties of northern Derbyshire are due to the Carboniferous or mountain limestone, which accounts for the gorges of the Dove and Derwent. The sylvan glories of the lower hills, Sherwood Forest, and Delamere Forest in Cheshire are due to the sandstones. The mountain limestone yields ores of lead, zinc, and copper; the Keuper marl gives quantities of rock-salt.

Rainfall. In a small area such as this, with so small a variation in elevation, the chief climatic factor is the rainfall. It may be noted, however, as one of the causes of the difference in rainfall between the eastern and western plains that the eastern plain is several degrees colder during the winter

than the western plain, in consequence of the fact that the winter anti-cyclonic conditions tend to spread from the continent over Nottinghamshire more frequently than over Cheshire, and that therefore the winter months in the east tend to be drier.

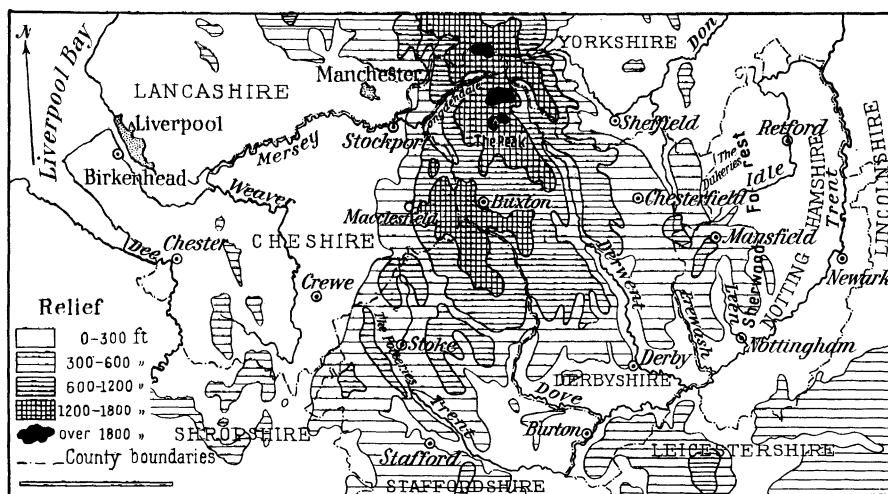


FIG. 1—The Southern Pennines: Relief.

Note. The line in the lower left corner of Figs. 1 to 3 represents a distance of 20 miles.

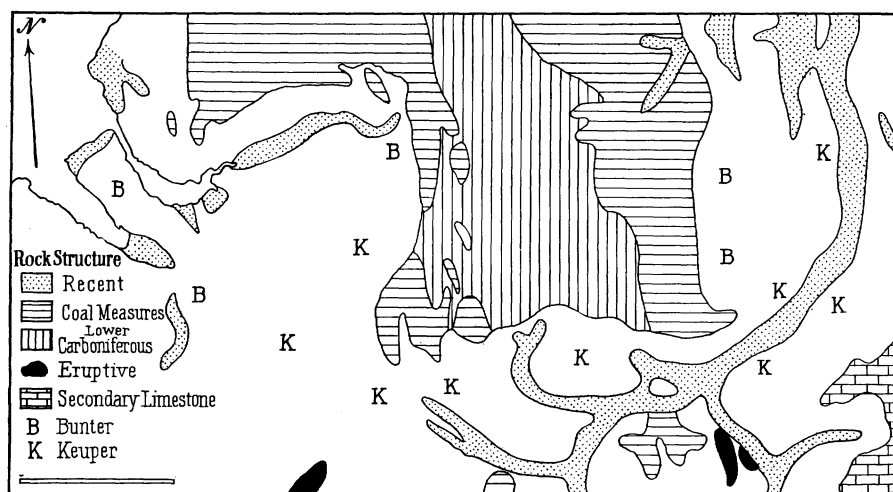


FIG. 2—The Southern Pennines: Rock-structure.

The distribution of the total annual precipitation is indicated in Figure 3, where it may be seen that the higher the land the heavier the total annual rainfall, while the eastern plains are drier than the western plains. The 30-inch isohyet on the east of the uplands tends to coincide with the 500-foot

contour, while on the west the 500-foot contour is close to the 40-inch isohyet.

But the most important fact regarding the rainfall of this district lies in the effect of the prevalent warm winter conditions upon the hills, especially upon their western slopes. During the winter the hills are very much wetter than the plains, and during the summer the plains are very much wetter than the hills; the word *wet* in this connection being used in a special sense with reference not to the total fall of rain but to the percentage of the total annual fall which occurs during the periods named. The hills have a large proportion of their rain in the winter, so that it appears probable that the excess rainfall upon the hills in comparison with that upon the plains is

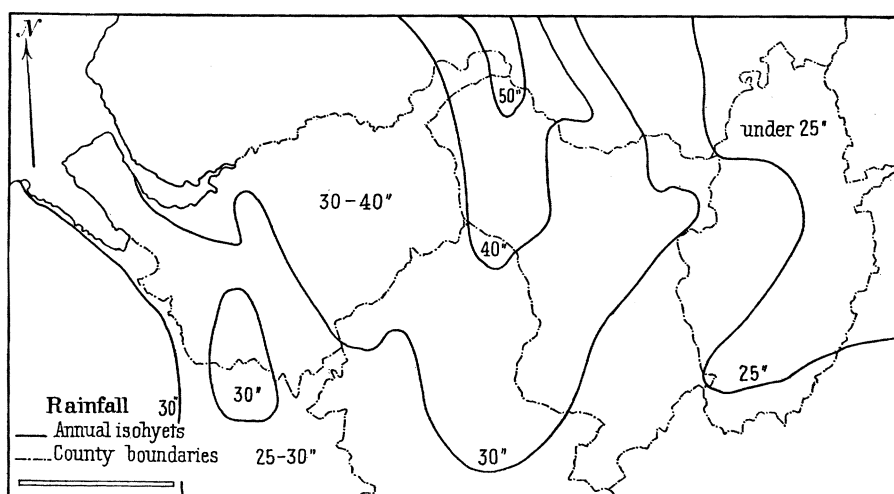


FIG. 3—The Southern Pennines: Rainfall.

due to an amount of precipitation during the winter which is superposed on the hills only during that season.

One other difference is of importance. In the Trent valley in Nottinghamshire there is a probability of specially heavy rain splashes during the months of June and July, with the inevitable consequence that the farm-land near the river is frequently flooded during the period when the crops are ripening. The total precipitation suffices for the hill streams, many of which have been, and some of which still are, used as sources of water power.

To some degree the Cheshire lowland shares in the noteworthy humidity of the atmosphere which is characteristic of the Lancashire plain farther to the north.¹ This humidity is of especial value in connection with those val-

¹ For a fuller examination of the rainfall conditions of the Southern Pennines in relation to the monthly variations in intensity, with particular reference to the areas where the cotton factories are most numerous, the reader may be referred to a paper by the writer on "The Rainfall of the Southern Pennines," published in the *Quart. Journ. of the Roy. Meteorolog. Soc.*, Vol. 40, 1914, pp. 311-322 (discussion, pp. 322-326).

leys, such as Longdendale, which open out facing the southwest; since the moist air is, as it were, forced into a steadily narrowing gap which increases the percentage of moisture in the air. In this respect Longdendale will necessarily have a more humid atmosphere than Derwentdale, which slowly opens out towards the southeast.

CHANGES IN THE DISTRIBUTION OF THE POPULATION

The accompanying maps (Figs. 4-6) which show the density of the population are based upon the Census reports of England. The areas which have been considered are the smallest administrative units, the parishes, and the three maps, here published, are typical of the manuscript maps

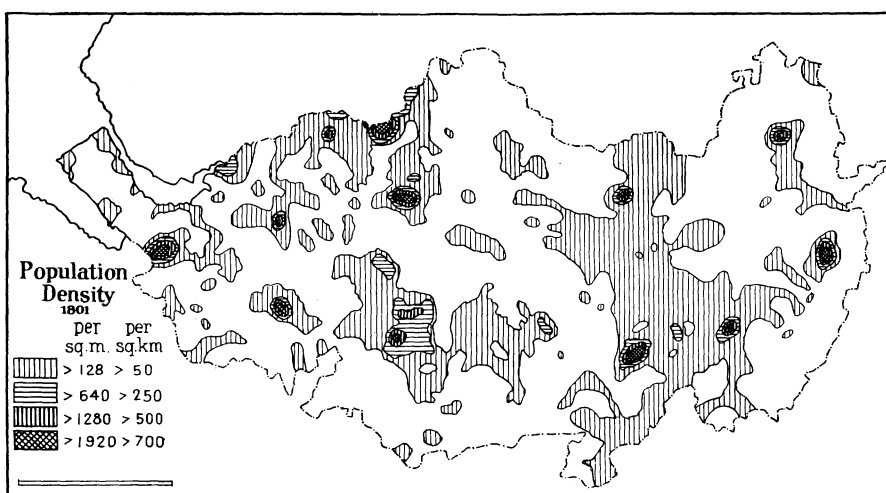


FIG. 4.—Density of the population in 1801.

Note. The line in the lower left corner of Figs. 4 to 6 represents a distance of 20 miles.

which have been made for each of the eleven census years beginning at 1801 and ending with 1901. They present three stages in a gradual change, in some areas progressive and elsewhere retrogressive, which has been operative throughout the century.

The population lines which are drawn upon the maps embody the same principle as that which is utilized in the mapping of contours and of climatic lines such as isotherms. The density value for each parish was entered upon a map and the numbers so entered were treated in the same fashion as "spot heights" in the drawing of contours.²

In 1801, the district was relatively scantily peopled (Fig. 4). More than half the area contained fewer people than 128 per square mile. There were nuclei of people in the towns which are strung along the Trent valley,

² For a discussion of various methods of representing population values upon maps, the reader may be referred to a paper by the writer on "Distribution of Nationalities in Hungary," which was published in the *Geogr. Journ.* for March, 1916.

Stoke, Derby, Nottingham, Newark, and Retford. Along the south bank of the Mersey were Stockport, Altrincham, and Runcorn. The ancient town of Chester was a crowded place, and there were isolated urban areas at Nantwich, Northwich, Macclesfield, and Chesterfield. In most cases the

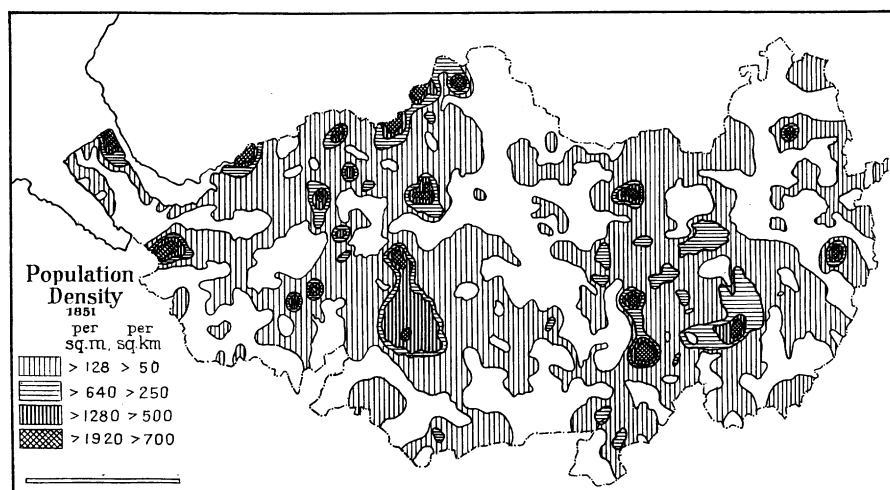


FIG. 5—Density of the population in 1851.

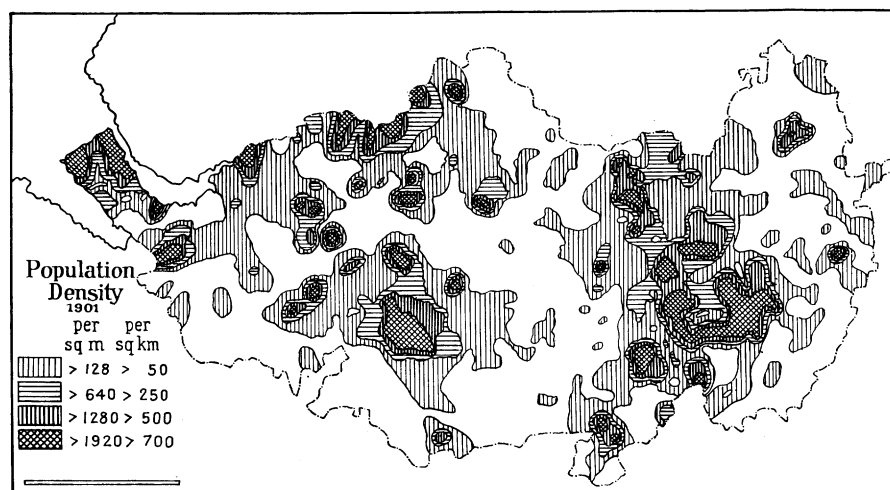


FIG. 6—Density of the population in 1901.

change from urban to rural proportions was rapid; the single exception was to be found in the Potteries round Stoke. The rural population tended to be most dense in certain definite directions, along the Trent valley, northwards along the Erewash valley, past Chesterfield in the direction of Shef-

field, towards the Potteries from Stockport through Macclesfield, and slightly away from the Mersey from Stockport towards Chester.

The distribution in 1851 (Fig. 5) resembled that of 1801 except that the areas of higher population had tended to spread and in some cases had coalesced. The Potteries area had grown to include Congleton, the Stockport area had spread eastwards to include Glossop in Longdendale, the Derby area had spread up the Derwent valley to include Belper, the Nottingham area had grown to include Ilkeston. Newark and Chester, towns of relatively great age, grew but little. Birkenhead had become important in consequence of the establishment of ferry communication across the Mersey estuary with Liverpool. The rural areas show little more than the natural increase of an agricultural population which remained attached to the villages. The map indicates that there had been relatively little migration from the rural to the urban areas, since the urban areas are still relatively small in comparison with the area of the whole district.

By the end of the century there had occurred great changes (Fig. 6). In the first place, the rural areas now contained, on the whole, fewer people than in 1801; there had been a migration out of the country districts which had exceeded in numbers the natural increase of the population during half a century; in some districts the population was sparser than in 1801. In those areas, every 100 persons in 1801 should have increased during the century to 300 at least, yet, in fact, they had decreased in some cases to about 75. The urban areas had grown denser and larger. The most striking urban increase occurred between Ilkeston and Chesterfield and both east and west from Stockport. Birkenhead had grown larger as a town of increased shipping with new docks and ship-yards and also as a dormitory for Liverpool. There had occurred a distinct shifting of the mass of the people; the decline in population in the area which occupies the center of the map is notable.

It may be well to try and picture a rural scene, such as has maintained almost an unchanged distribution of population during the century. A cluster of small houses nestles near the church, and farmyards are separated only by a brick wall from God's acre. Outwards, in all directions, the small fields with typically English hedgerows; here and there, dotted over a landscape with gentle undulations, an isolated farm. With a slight turn of the head the eye sweeps over an area of about fifty square miles, and if one counts the cottages and farms they will not number a hundred. Somewhere close by is a main road, often dating back like Watling Street or the Fosse Way to Roman times; centering on the tiny village are the minor roads. Nowadays the main roads are used by travelers who sweep along in speedy motors, the minor roads are traversed by farm wagons, by the carts of the butcher and the baker, or by vans which deliver commodities from the nearest large town. Such a scene is typical over the major portion of the country. There are subtle differences in Cheshire; trees line the fields,

and coppices and spinneys are more frequent; nearer the high ground, hedges give place to stone walls; in the east, ploughed land or growing crops take the place of the commoner pasture land in the west.

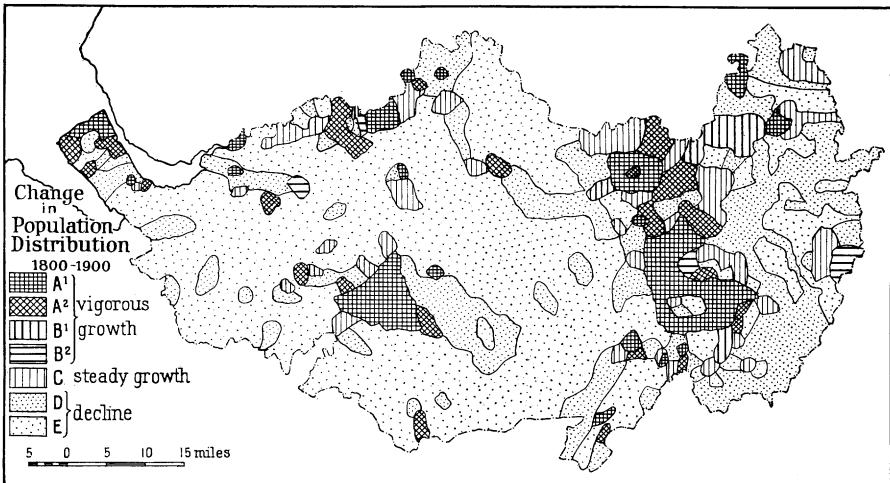


FIG. 7.—Changes in the distribution of the population during the nineteenth century.

The changes which occurred during the century are summarized in Figure 7. The district is divided into five types, wherein the changes had occurred that are indicated by the graphs in Figure 8. In the areas of group C the rate of change of the population had been steady and equivalent to the average for England as a whole; the population had trebled itself. These parishes are scattered and small in total area. The people indicated in group D were proportionately as numerous in 1901 as in 1801; the areas so indicated had seen an increase in density during the first half century and an almost equal decline during the second half century. Such areas are particularly large in the county of Nottingham. The largest areas are those of group E, where the population had declined in numbers, especially since 1851.

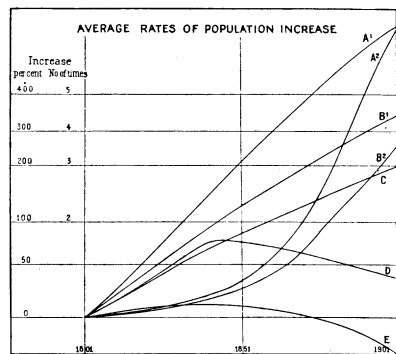


FIG. 8.—Average rates of increase of the population. (The symbols correspond with those on Fig. 7; for their precise meaning, see the text.)

Groups A and B contain those parishes where the population had multiplied five and four times respectively; in some of the parishes (groups A¹ and B¹) the rate of increase had been steady and continuous throughout the century; in the others (groups A² and B²) the growth occurred almost

entirely during the second fifty years. Figure 7 indicates the great importance of the district between Ilkeston and Chesterfield, the great growth of the compact area of the Potteries, the expansion of Stockport, and the rise of Birkenhead. Maximum progress of this type becomes evident to the traveler by the continuity of the brick buildings—houses and factories—which line the roads and tend to fill in the intervening spaces. It ends eventually in an amalgamation of townships such as the recent combination of Hanley, Stoke, Burslem, etc., into the single town of Stoke—the “Five Towns” of Mr. Arnold Bennett’s novels. It is manifest by the difficulty which is experienced in determining where Stockport, say, ends and Hazelgrove begins.

THE FIRST HALF-CENTURY

The industrial revolution of the later years of the eighteenth century had given life in northern England a definite stimulus towards the growth

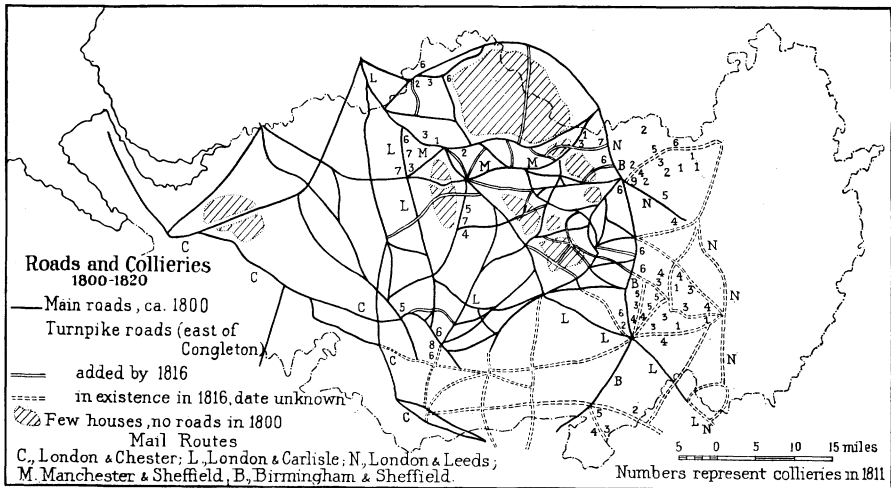


FIG. 9—Roads and collieries, 1800-1820 A.D.

of manufactures, and the first fifty years of the nineteenth century were, therefore, a period of experiment and adjustment.

Again and again factories were established, operated for some years, and finally closed as failures; these were typical experiments by which the northerner tested the possibilities of his environment. The needs of the increasing number of factory hands caused the farmers to alter gradually the basis of their agriculture, and the requirements of industry occasioned developments in transport, inventions of new machinery, a greater need for coal; and life within this area only gradually adjusted itself to these changing conditions. The old records are in many cases scanty, and those which are available are not of uniform excellence; it will suffice to specify two examples. In 1795, Dr. John Aikin published “A Description of the

Country from thirty to forty miles round Manchester'' which is of surpassing importance on account of the valuable facts which are recorded and also because of the map which illustrated the text. During the first decade of the century the Board of Agriculture published reports upon the agriculture of the various counties, and of these Farey's account of Derbyshire excels the rest in consequence of its thoroughness and of its maps. Figures 9 and 10 are based largely upon these two sources of information, and they betray, at once, the lack of uniformity which exists in the old records. On this account it will probably be wise to consider the first half-century in general for the whole area and to devote attention during the second half-century to the major lines of development and decay. This plan has especial merit, since the population as a rule progressed generally and uniformly during the period 1801-1851 (Figs. 4 and 5).

During these years the bulk of the population depended upon the land;

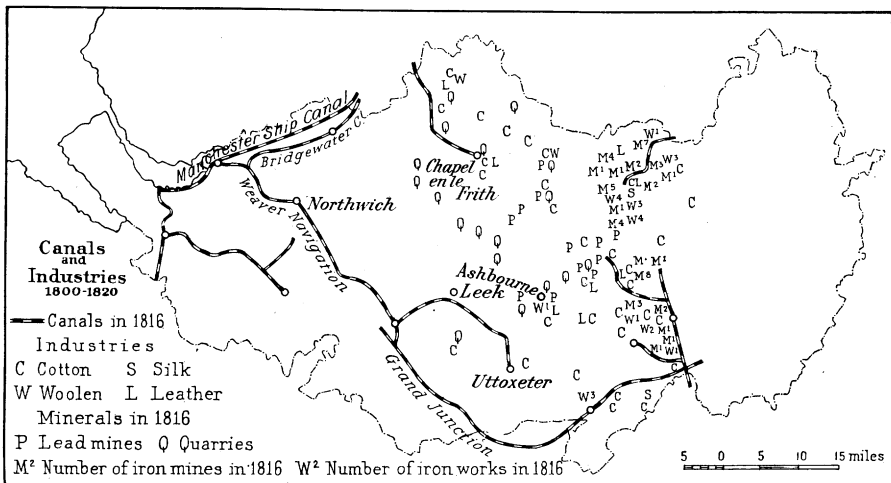


FIG. 10—Canals and industries, 1800-1820 A.D.

they were interested in the farms, which stretched over the whole of the area, except the limestone and gritstone moors of Derbyshire and the sandstone forested areas such as Delamere. (Figure 9 shows the patches with few houses and roads.) On the Cheshire side the view from the edge of a scarp such as that of Macclesfield lay over a countryside which presented the appearance of dense woods, but this appearance was deceptive, for there were few woods. The fields were small, they were bordered by hedgerows, with frequent and fairly large spinneys which were sufficiently numerous to give the impression of continuous woodland. On the uplands lay the stone-wall country where the farm-lands were bounded by stone walls instead of hedgerows. Southwards lay the flat lands of the Trent, which were continued eastward in more open farm-land with numerous meadows near the

river and the tributary streams. All the lowland farm-land contained a stiffish clayey soil, above the Keuper, lightened wherever the farmer had adopted the practice of marling, for the marl pits where the sub-stratum of the Keuper marl had been reached were common to many farms. In consequence of the greater rainfall of the west, pastures were more frequent in Cheshire and Staffordshire than in Nottinghamshire, with the result that oats and milk and cheese, with an increasing acreage under potatoes, characterized the western farms, while barley and wheat and flocks of sheep mark the drier eastern lands. Throughout Cheshire oats were ground into meal and formed the staff of life for the poorer people. Along the south side of the Mersey potatoes were grown and sent to Manchester and Liverpool for sale. Near Nantwich and along the upper Trent the manufacture of cheese was important during the early years; some was sent by sea from Chester and Frodsham to London and the rest was sent by road to Lancashire and Yorkshire. Agents visited the farms in Derbyshire in August and bought the cheese for the London market; most of it was transported by sea from the east coast port after a river journey down the Trent. With the advent of the railways the milk trade with the towns of southern Lancashire caused a decline in the production of cheese, but the pastures were still necessary for the store beasts which were brought into the district from the north and fattened for the butcher. The lower-class farmers rarely ate fresh meat, but the greater wealth of the factory operatives gradually led to a growing trade in meat. Dovedale was notable for its cattle. These facts kept the Cheshire farms small and intensified the need for farm laborers, which gave rise to the developments in the rural population shown in Figure 5. Intensive farming of this nature implies the use of manures, and lime was taken from the quarries at Chapel-en-le-Frith over the roads on the backs of small Welsh ponies for the farmers in Longdendale.

In Cheshire over 90 per cent of the land was farmed, and three-quarters of the farm-land was under grass. The spinneys provided oak bark and the cattle provided hides, so that Nantwich and Newcastle, for example, made shoes and leather bands for the machines of the factories. Before the days of railways milk was sent to the centers of population from the surrounding farms in barrels slung on the backs of asses or ponies. In Staffordshire two-thirds of the farms were under grass, and both in Staffordshire and western Derbyshire much barley was grown for the brewers at Burton.

The countryside, therefore, consisted largely of farm-land based upon the valley lowlands, crossed by the main roads, which were linked together by numerous dirt lanes. The cottages bordered the lanes, and the farm houses lay back among the fields. Only in the wealthier districts had the use of bricks and tiles begun to improve the appearance of the cottages, so that a contemporary writer could still describe a waterside village not

far from Chester as a "specimen of pure barbarism." Most of the main roads were in use for through traffic for the mail-coaches, and many of the purely agricultural townships such as Nantwich, Newark, and Retford owed much of their importance and wealth to the traffic which passed along the roads.

There were four areas notable for extractive industries. In the Weaver valley salt was obtained. The salt traffic had begun to concentrate upon Northwich and had affected Frodsham and Runcorn favorably. Some 50,000 tons per annum were exported to Ireland for curing provisions, and to Dunkirk, Ostend, Bruges, Riga, and Elsinore. This salt passed to Liverpool by the Weaver Navigation and thence as ballast in out-going ships. The evaporating pans were now made of wrought iron, and the coal necessary for fuel was supplied from Lancashire as a return cargo for the river boats.

Coal was mined east of the Pennines, in the Coal Measures which flank the upland continuously. Almost from Derby to Nottingham and in the north round Chesterfield collieries were numerous, and in this district ironstone was also largely obtained. On most of the upland between Macclesfield and Stockport and in Staffordshire near Cheadle and in Derbyshire south of Burton there were small groups of pits. Much of the coal was used locally, yet some was sent short distances by pack-pony and by canal from southern Derbyshire to Leicestershire, and from Chesterfield to the counties of Nottingham and Lincoln, by way of the river navigation which began at Bawtry on the Idle. In the mountain limestone were lead mines, which were, at that early date, much troubled by in-flowing water, which was removed by hand-, horse-, and steam pumps. At Wirksworth lead was smelted and sent to London via Bawtry.

Limestone was quarried at various places, while saw-mills for making paving stones were worked, by water wheels, at Bonsal and Cromford, and, by steam, at Mansfield and Wirksworth.

As early as 1811 it was noticed that the exhaustion of lead mines caused a decrease in the number of houses at Tideswell and Moneyash.

The district contains three centers of industry: the Potteries, the attenuated line of cotton factories which stretched from Stockport across to Derwentdale and down the valley to Belper, and the iron works of eastern Derbyshire, both north and south.

In regard to cotton factories it must be noted that the great work of Arkwright was carried out in Derbyshire; during the later years of the eighteenth century cotton spinning mills were built at Cromford by Arkwright, at Belper and Milpond by his associate, Strutt, while others were erected at Glossop; by the beginning of the nineteenth century there were 37 mills in Derbyshire. In 1788, out of 123 water-mills engaged in the cotton trade in England, 22 were in Derbyshire, 8 in Cheshire, and 7 in Staffordshire. The driving force being water-power, the mills were situ-

ated up the valleys of Longdendale and Derwentdale; the first application of steam power to these mills consisted in the use of steam pumps to supply water for overshot water-wheels. Hand knitting of stockings was a common domestic industry, especially in the district between Derby and Nottingham. The invention of a rib machine caused a gradual localization of the stocking industry in factories situated in this district, of which Nottingham became the chief center. At Stockport, Aikin notes 23 cotton factories, four of which had steam engines. The combined use of water and steam for power lasted well into the century, for at Quarry Bank near Stockport a mill was built in 1877, partly driven by water. This mill, like others which had previously been in operation at Wilmslow in the neighborhood, failed. Farther south, near Macclesfield, the early mills based upon water-power one by one ceased work as the century grew older.

In Longdendale the cotton mills steadily increased in number; by 1820 at least 50 were hives of industry in the Glossop district, and these formed half the total number at work in Derbyshire. The factories were not limited to the spinning of cotton, since calico, muslin, and cambric were woven and there were four factories each engaged in calico printing, bleaching, and dyeing. In Staffordshire there were mills about 1820 at Rocester and Burton. Aikin notes that just before the century opened about 23,000,000 pounds of cotton were imported, about two-thirds of which came from the West Indies, and about half of which was used in the manufacture of calico and muslin, and that the total value of cotton goods made was about eight millions sterling. From other sources it may be estimated that the average imports of cotton in 1800, 1810, and thence by decades to 1850 were respectively, in million pounds, 50, 100, 140, 250, 500, and 725. This development coincided with the introduction of steam power, the development of the coal fields, the use of railways, and a great concentration of the cotton mills towards the towns, in which they are most numerous at the present time.

The Potteries were a collection of villages which lay roughly along the outcrop of quick-burning coals and clays suitable for the manufacture of earthenware. The district and the staple industry had already received a stimulus from the work of Wedgewood, but was handicapped by difficulties of transport, since the roads were bad and the pots had to be carried on the backs of pack mules for many miles. Newcastle, a residential town where boots and shoes were made, lay to the west of the Potteries, which centered upon Burslem, Hanley, Stoke—where the first steam engine had been set up by Spode to grind burned flint for the use of the potters—Etruria, Longport, Lane End (later called Longton), Cobridge, and Shelton.

In connection with the manufacture of iron goods Derbyshire in 1806 was the fourth county in importance in the United Kingdom. There were, in all, 18 furnaces with an annual production of 10,000 tons of pig iron.

Twelve furnaces were in blast and each had approximately the same annual output.

The first half century is notable on account of the changes which occurred in regard to transportation. When the century opened the canal era was in full swing, and it is important to note that the canals shown in the map, Figure 10, are the same canal routes which have been recommended as the most suitable for a great modern development of the canals of England. The Bridgewater Canal, the pioneer, traverses Cheshire south of the Mersey and was the precursor of the Manchester Ship Canal. There was a daily service of passenger boats along this canal from Manchester to Runcorn, which town had been rescued from oblivion by the canal, so that it gradually developed a chemical industry. Brindley, its famous engineer, had also helped in the construction of the Chesterfield Canal, which was to supersede the old river route via Bawtry. The needs of Cromford had led to the construction of the canal to join the Erewash Canal, which connected the collieries of eastern Derbyshire with a market in Leicestershire. The disabilities of the Potteries and the salt towns had led to the construction of the Grand Junction waterway with the aid of the Weaver Navigation to join Stoke with the Mersey estuary and also with the collieries of southern Staffordshire. China clay from Cornwall was brought to the Mersey and sent by canal to Stoke, coal was brought northwards. These canals embodied the principle of the maintenance of a water level, and the Erewash Canal winds inconveniently along by the side of the river along the 100-foot contour, except where it crosses the mouth of tributary streams over an embankment; the Peak Forest Canal was noted for its aqueduct at Marple Dale, 93 feet in height and 309 feet long, reputed to be one of the largest in England. The utility of the canals may be estimated from the following charges for the conveyance of a ton of goods from Liverpool to Manchester: by road, 40 shillings; by the canalized river Mersey, 12 shillings; by the Bridgewater Canal, 6 shillings. By the canal a 50-ton boat performed three trips a fortnight, while by the river three trips occupied a month. From Liverpool to Etruria the charge per ton by road was 50 shillings, by canal but 13 shillings 4 pence; freights from Manchester to Derby and Nottingham were halved.

Closely connected with the canals progress occurred in shipping in the Mersey and affected Birkenhead, which was a thinly peopled agricultural district in 1801. Between 1801 and 1820 sailing ships were still in use, and it is recorded that on one occasion a vessel which got out of the estuary before the wind changed sailed to Barbados and back before the other vessels for the West Indies were able to leave harbor. Even so late as 1834 the great spring fleet of 133 ships was held up in the estuary for six weeks by contrary winds, in company with other ships, so that when the wind was favorable 400 vessels departed in one day. The rise of Birkenhead is associated with two factors, first the establishment of steam ferries

to Liverpool in 1828 and secondly the establishment of Laird's shipbuilding yards in 1824 and the docks in 1843. Laird's built the first iron vessel in England in 1829, and, later, the famous *Alabama*. The introduction in 1837 of steamships from the Mersey to the United States reduced the time of the voyage from 28 to 10 days. In 1845 screw steam vessels came into use.

During the early years the roads were of great use, especially for through traffic, and it is noticeable that the majority of the main roads connect cities to the north with London or other cities to the south. For example, the Great North Road passes through the district from Newark to Retford, and its importance was so great that the mails for Nottingham were sent westwards from Newark. The great western road—Watling Street—

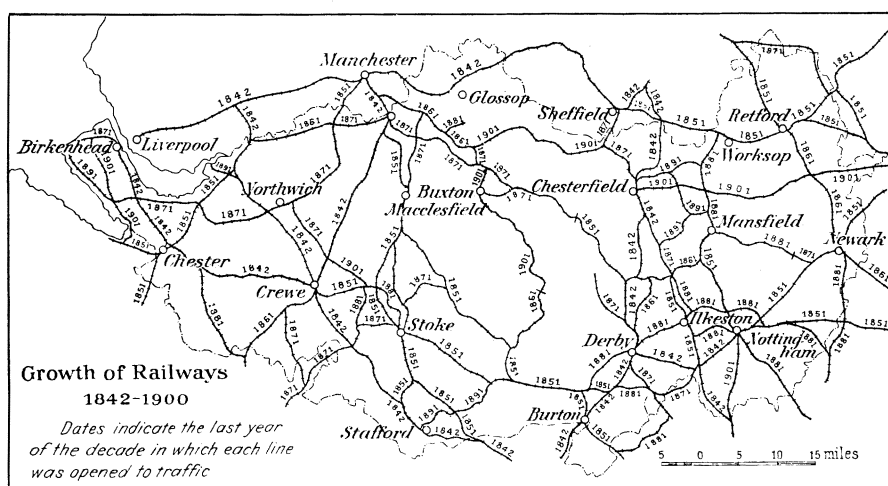


FIG. 11—The growth of railways during the nineteenth century.

passed through Staffordshire and Cheshire and maintained the prosperity of Nantwich and Cheshire during these early years.

The railways date from the first English railway, that between Manchester and Liverpool, opened in 1830. During the decade which followed this date the Midland Counties and the North Midland line were inaugurated, largely for the purpose of providing transport for the coal of eastern Derbyshire. These lines, which were later the basis of the Midland Railway, one of the chief English lines, were planned in a small inn situated in the heart of the colliery district, and in consequence the headquarters of the Midland Railway have remained at Derby. By 1841 the "West Coast" route from Scotland, which traverses the area and centers on the great railway junction at Crewe, was complete from London to Preston, and the "East Coast" route took its original track through the coal fields of eastern Derbyshire from York to the metropolis. The map, Figure 11, shows that by 1851, in addition to these two great cross-routes, connecting links had been established which gave a route from Birkenhead through Stoke, Derby,

and Nottingham to Newark, and from Chester through Manchester, Glossop, and Sheffield to Retford. By this time the lowlands were comparatively well served with railways.

THE SECOND HALF-CENTURY

During the period 1851-1901 life in England, perhaps more than anywhere else in the world, underwent a great change of outlook; parochial affairs ceased to have much importance; the Englishman, willy-nilly, acquired some interest in the wide world, for his very existence depended upon circumstances which arose beyond the seas and which affected his existence more and more completely, as railways and steamships, telegraphs and cables achieved success and made the commercial world relatively smaller and more compact. A multitude of influences were at work, and it will not be possible to do more than indicate some of the major forces which affected the people of the Southern Pennines.

The Farmer and His Environment. By the courtesy of the Board of Education it has been possible to obtain from their records the facts which are tabulated below. Groups of contiguous parishes were selected upon the basis of rock-structure and the facts referring to the farm-work of these parishes are indicated in the tables, while the facts regarding the population are shown in Figure 12. Considering the diagram first, it becomes obvious that the farming population has steadily declined since 1851, while it steadily rose during the earlier fifty years: the slope of the curves in Figure 12 indicates that the rate of regression was on the whole slower than the rate of progress; this general feature is exemplified for all the farming districts by the areas labeled D and E in Figures 7 and 8.

Turning now to the tables, we see that the greater portions of the selected districts were under cultivation; the influence of the rainfall is clearly shown, however, since the wetter west contains about 50 per cent more grass than the drier east. Rainfall has a greater effect in this connection than either elevation or rock-structure. Two-thirds of the arable lands was usually under cereals, wheat, oats, and barley, and this proportion remained fairly constant despite (1) a decreased arable acreage, (2) changes in the proportion of wheat in comparison with oats. Barley was only grown in the east, and, whenever it was grown extensively, it maintained its proportion to the total arable area. Wheat gradually declined in importance; about 1870, rainfall and rock-structure had little influence in determining the area under wheat, but with the decline it became obvious that wheat cultivation on the Bunter sandstone was less satisfactory than upon the Keuper, so that the farmer responded to the effects of world competition by cutting down his wheat acreage and by maintaining wheat only where most successfully cultivated,—on the stiffer soils of the Keuper. The effect of the heavier rainfall on the west, the cooler temperatures of the hills and of the displacement of wheat is shown by the

general increase in the importance of oats, which are affected by two other local facts: (1) the need of fodder for the increased number of horses in the factory areas and (2) the use of oat straw for packing pottery wares. The trade in milk to the factory towns, the manufacture of cheese, and the preponderance of grass are all connected with the proportionately large numbers of cattle in Cheshire in comparison with Nottinghamshire; the Keuper marl usually carries more cattle than the Bunter sandstone. The

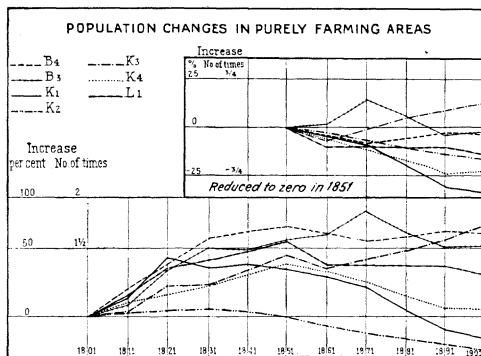


FIG. 12—Variations in the population in purely farming areas. (For key to symbols, see footnote to table opposite.)

mountain limestone carries sheep well, but the sheep area of greatest value is the Bunter sandstone of the drier east; and where there are many sheep there are many fields of turnips. The noticeable changes which occurred from 1870 to 1901 indicate the effects which world progress—a dynamic factor—produced upon the life of the farmer. The distinguished agriculturist, Mr. A. D. Hall, in “A Pilgrimage of British Farming,” comments upon the intensive farming of small holdings from 30 to 200 acres in Cheshire; “the main-stay of Cheshire farming is milk production.” The Cheshire farmer usually has two years of oats, one of potatoes and other roots, and one of seeds every four years. In Derbyshire, on the mountain limestone, in the stone-wall country, he found the farms small, about 50 acres, and dependent on milk which is sold to cheese makers, as southern Derbyshire is the home of the Stilton cheese.

The result of the changes for the farmer during the nineteenth century may be, therefore, summarized. For approximately seventy years the farmer worked for local needs in accordance with his opportunities; he sold barley to brewers at Burton, oat straw to the potters, milk to nearby growing towns, some cheese to factors for the London market; he grew wheat and potatoes for the population of the neighborhood. Since 1870 he has grown less wheat, since England has steadily bought more and more wheat abroad, and he has steadily settled down in the west to produce milk and cheese for the factory workers. In the drier east he has retained his interest in sheep on the sandstone country and in cattle and wheat on the marls and clays. Throughout the area he has declined in numbers, and the farther he was removed from the towns the more rapidly have his numbers declined. Over and over again it is recorded that the rural population had migrated to the factories; the frequency of small farms indicates the dearth of agricultural laborers; usually the farm is worked by one or two men.

the mountain limestone carries sheep well, but the sheep area of greatest value is the Bunter sandstone of the drier east; and where there are many sheep there are many fields of turnips. The noticeable changes which occurred from 1870 to 1901 indicate the effects which world progress—a dynamic factor—produced upon the life of the farmer. The distinguished agriculturist, Mr. A. D. Hall, in “A Pilgrimage of British Farming,”

TABLE SHOWING THE RELATION BETWEEN AGRICULTURE AND ROCK-STRUCTURE

GROUP*	I AREA OF CULTIVATED LAND: PER CENT OF TOTAL AREA				II AREA OF GRASS (PERMANENT AND ROTATION): PER CENT OF I				III AREA UNDER WHEAT ^a			
	1870	1881	1891	1901	1870	1881	1891	1901	1870	1881	1891	1901
B1.....	77	86	84	80	36	43	50	46	18	13	5	7
B2.....	73	89	87	87	57	66	66	63	27	23	21	20
B3.....	78	81	81	81	78	85	90	91	32	23	12	8
B4.....	88	99	97	98	34	36	43	43	36	28	22	12
K1.....	86	94	91	92	78	82	86	89	35	31	26	28
K2.....	89	86	91	94	53	57	59	60	26	29	28	23
K3.....	63	60	82	81	71	70	75	73	24	17	10	9
K4.....	62	69	71	71	46	50	54	57	34	28	31	24
S1.....	89	87	90	88	82	88	90	92	19	21	20	8
S2.....	85	85	82	80	62	68	72	75	38	34	30	25
S3.....	91	93	88	92	70	73	80	81	32	32	32	32
L1.....	84	90	87	90	88	92	94	93	1	2	..	..
L2.....	30	41	40	39	94	96	98	98	14	8	..	3
L3.....	79	78	79	78	44	51	55	58	26	21	24	18

GROUP*	IV AREA UNDER BARLEY ^a				V AREA UNDER OATS ^a				VI AREA UNDER TURNIPS ^a			
	1870	1881	1891	1901	1870	1881	1891	1901	1870	1881	1891	1901
B1.....	23	21	21	23	17	25	34	35	32	32	30	29
B2.....	6	3	6	5	30	35	36	36	12	13	14	11
B3.....	7	4	1	2	33	45	57	68	8	11	13	13
B4.....	23	22	24	23	4	9	17	22	24	27	26	27
K1.....	5	11	3	5	25	26	31	31	6	8	14	14
K2.....	22	27	25	26	4	6	6	14	13	15	20	19
K3.....	1	..	1	1	42	44	52	56	9	7	7	8
K4.....	18	22	17	22	4	9	10	10	10	10	10	12
S1.....	9	4	3	1	35	42	37	46	12	13	13	7
S2.....	9	8	6	7	22	27	34	39	12	15	17	17
S3.....	17	13	10	6	17	23	31	28	9	12	15	14
L1.....	..	..	..	..	65	69	54	67	17	13	23	16
L2.....	2	..	2	4	52	53	54	48	11	8	14	12
L3.....	25	26	25	25	12	15	17	23	21	22	20	20

GROUP*	VII TOTAL OF III, IV, AND V CEREALS				VIII NUMBERS OF CATTLE PER 1,000 ACRES OF GRASS OF BOTH KINDS				IX NUMBERS OF SHEEP			
	1870	1881	1891	1901	1870	1881	1891	1901	1870	1881	1891	1901
B1.....	58	59	60	65	176	167	157	145	2,390	2,500	2,090	1,390
B2.....	63	61	63	61	368	268	255	248	730	555	1,015	350
B3.....	62	72	70	78	406	378	521	521	440	76	263	130
B4.....	63	59	63	57	276	286	293	249	1,740	1,680	1,830	1,740
K1.....	65	68	60	64	410	410	450	420	510	100	420	270
K2.....	52	62	59	63	407	450	431	415	875	425	595	440
K3.....	67	61	63	66	650	458	320	335	357	113	180	300
K4.....	56	59	58	56	456	405	425	390	1,080	416	394	440
S1.....	63	67	60	55	350	329	397	365	502	250	414	315
S2.....	69	69	70	71	280	254	292	260	591	315	362	311
S3.....	66	68	73	66	365	295	320	270	528	110	425	243
L1.....	66	71	54	67	280	255	280	282	1,020	895	715	450
L2.....	68	61	56	55	350	301	301	296	805	720	800	785
L3.....	63	62	66	66	322	291	326	284	1,130	670	630	430

* Key to Groups of Parishes.

B1=Bunter highlands in Nottinghamshire.

B2= " lowlands in Wirral Peninsula.

B3= " " southwestern Cheshire.

B4= " " Nottinghamshire.

K1=Keuper marl near Derby.

K2= " " Nottingham.

K3= " " Knutsford (area before 1881

different from that after 1881.)

K4=Keuper marl near Retford.

S1=Coal Measures near Cheadle.

S2= " " Chesterfield.

S3= " " Ilkeston.

L1=Mountain limestone, highland, near Bakewell.

L2=Carboniferous rocks, highland, near the Peak.

L3=Permian limestone in Nottinghamshire.

^a Per cent of arable area less area of rotation grass.

The Miners: Failure and Success. Mention has already been made of the lead mining which occurs in the mountain limestone, especially in the

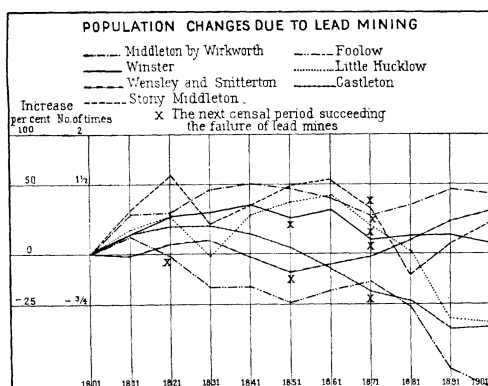


FIG. 13—Population changes due to lead mining.

with the difficulties of working the mines, owing to the water which percolates through the limestone. In 1873 Britain produced 74,000 tons of lead ore; this output had dwindled to 28,000 tons in 1901. In that year Derbyshire produced 3,000 tons, about a fourth of the total output of England.

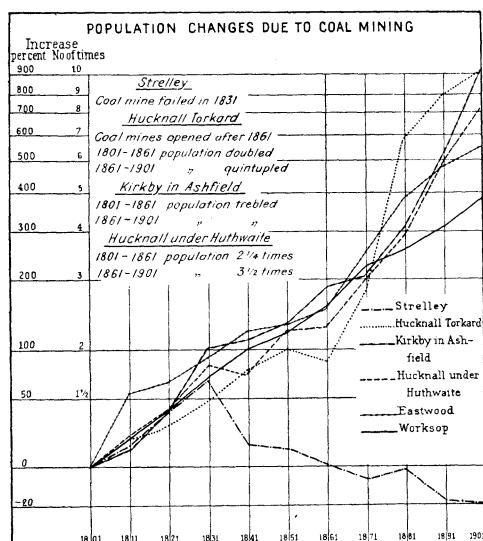


FIG. 14—Population changes due to coal mining.

on the whole, normal. This district yielded 56,000 tons of rock salt in 1901, which was just over half the total production of England. The British production of salt has been approximately steady since 1881 at 2,000,000 tons annually.

neighborhood of the middle Derwent. This industry is a comparative failure. Figure 13 indicates how the failure of lead mine after lead mine contributed to the decline in population which is characteristic of northern Derbyshire. This failure is due to two forces; the first, dynamic, is connected with the more efficient lead mines which have been operated in other parts of the world, and the second, static, is connected

In 1882, the four chief lead mines were at Great Hucklow, Haddon, Crich, and Wirksworth, and in these about half the total output of the county was obtained. No other mine yielded as much as seventy tons per annum, and thirty smaller mines are specified in the mining records as yielding less than ten tons each annually. By 1901 the decline had been so general that only twelve mines could be specified from each of which the annual yield amounted to at least five tons.

Salt mining is localized in the Weaver Valley, where the progress in population has been,

In tune with the prevalent tendency towards industrial concentration the salt mines have ceased in outlying places such as Nantwich, and the chief centers since 1882 have been Northwich and Malpas. Salt mining has affected the population chiefly by the growth of the dependent industry of chemical manufacture and has caused the growth of Northwich and Runcorn, as well as neighboring towns north of the Mersey, as definitely urban factory towns.

The chief mines are the collieries. The coal mines were important before 1851, but their relative importance has steadily increased since that date, so that the colliery areas are usually indicated by so great a growth of the population that it increased from sixfold to tenfold during the century (Fig. 14). In Nottinghamshire the pits have gradually extended eastwards, but near Macclesfield they have declined. The following table indicates the number of pits in operation at the dates named, and it may be remarked that a pit in 1901 was a vastly more productive place than in 1811.

NUMBER OF COLLIERIES IN OPERATION

CHIEF TOWN IN DISTRICT	APPROXIMATE AREA OF DISTRICT IN SQUARE MILES	NUMBER OF PITS IN:—						
		1811	1854	1861	1871	1881	1891	1901
Stockport.....	60	29	19	26	27	35	19	24
Macclesfield.....	30	40	14	19	10	6	3	4
Stoke.....	80	25	123	128	111	144	146	122
Burton.....	30	14	7	11	10	16	23	18
Ilkeston.....	40	17	7	12	14	23	20	23
Ripley.....	40	19	11	14	13	17	20	19
Alfreton.....	80	28	21	23	22	31	19	28
Chesterfield.....	100	69	71	60	45	109	98	89
Nottingham.....	*	20	17	20	29	40	52	61

* Continually increasing, as pits were sunk through the Permian limestone and the Bunter sandstone to the east of the Coal Measures.

The table clearly indicates great progress everywhere except in the Macclesfield district; and this fact is emphasized by the next table, which shows that the output in Cheshire is small and declining while that of Nottinghamshire especially shows a remarkable increase.

COAL PRODUCTION AND PEOPLE EMPLOYED

COUNTY	COAL PRODUCED IN MILLION TONS				NUMBER OF MINES		PEOPLE EMPLOYED IN THOUSANDS		
	1854	1882	1891	1901	1854	1901	TOTAL 1854	1901	
								ABOVE GROUND	BELOW GROUND
Nottinghamshire.....	0.8	5.0	7.2	8.2	17	61	3.7	5.6	22.2
Derbyshire.....	2.4	8.4	11.0	14.9	117	177	5.4	10.0	39.9
Cheshire.....	0.8	0.8	0.7	0.6	33	28	2.6	0.6	2.2
North Staffordshire.....	...	4.9	5.1	(a)	123	122	(a)	(a)	(a)

(a) All Staffordshire in 1901, 13.1 million tons, 351 mines, 11.9 and 37.2 thousands of people above and below ground respectively; 25.7 thousands all told in 1854.

The change in value of each pit is important; for example, in 1854, there were in Nottinghamshire 17 pits with, on the average, 220 persons

employed at each, while in 1901 there were 61 pits with 450 employees each.

The coal miners form one of the chief elements in the populations of the districts labeled A^1 and A^2 in Figure 7; in fact, the distinction between the areas A^1 and A^2 is almost entirely due, in the County of Nottingham, to the fact that the pits were only opened in the Leen Valley (A^2) during the second half-century (Hucknall Torkard, Fig. 14).

These three minerals, lead, salt, and coal, are typical of three forms of population change (coal—great progress, above the normal; salt—normal development; lead—regression), and they exemplify how dynamic factors such as railway development, growth of nearby markets, the invention and use of steam engines, the need for new products such as bleaching powder override the purely passive factors such as rock-structure in utterly changing the lives of men. The Leen Valley shows this overpowering influence with great prominence. The traveler journeys southwards through Sherwood Forest. He is surrounded by sylvan glories, a wealth of gorse, dainty silver birches in clumps, and groups of majestic beeches. Suddenly he halts at the head of a valley. In the foreground the valley sides are cultivated and there is peaceful farm-land; the background is obscured by the rolling clouds of smoke from the pit heads in the middle distance. He reaches the collieries by a devious route, for there is no road which leads direct from the forest to the mine. He is in a narrow valley in which flows a tiny stream; the lowland is completely filled by railway tracks; three different railway companies have built their roads now side by side, now interlaced, again one crossing the others obliquely, and beside the tracks are the pit heads with their tall chimneys and winding wheels in alternation. Each pit steadily encroaches on the farm-land, which yields reluctantly; the rubbish from the mine lies in long hillocks which smoke from the combustion within, and crops grow within a yard or two of these unsightly mounds. The last years of the century saw a smiling farming valley become the busy home of thousand of miners.

Workers in the Coal-Fields. The beginnings of the manufacture of iron goods have previously been noted. The following table indicates the progress which was made during the second half-century in the areas indicated in Figure 10. The iron furnaces fluctuate in number considerably, but there is a steady increase in the average output per furnace during the period reviewed.

PIG-IRON PRODUCTION

DISTRICT	NUMBER OF BLAST FURNACES				TOTAL PRODUCTION IN 1,000 TONS			
	1861	1871	1882	1901	1861	1871	1882	1901
East Derbyshire	24	38	40	30	130	270	373	450
North Staffordshire	24	31	25	14	188	268	276	200

It is impossible to distinguish the effect of the iron works from that of the collieries in so far as they jointly affected the population in their neighborhood. A typical area for the dual industry centers on Ilkeston; the outlook is dreary in the extreme. To stand in Nottinghamshire, above the left bank of the Erewash, and see below you first the canal swung across the mouth of a side valley by a dirty brick viaduct, beyond the canal the dull and dirty river, the land between you and the stream a desolate waste, above which rises a dull dingy building on which the brightest spot is the escaping steam, and the far side of the valley thick with small brick and slate houses above the roofs of which project the larger gaunter buildings of iron works and factories, and over all a pall of smoke—is to view a dismal scene where there is no green of vegetation and the few trees stand gaunt and skeleton-like memorials to man's conquest of his environment. Mid-summer rain is falling, yet no amount of water could apparently make the district fresh and clean.

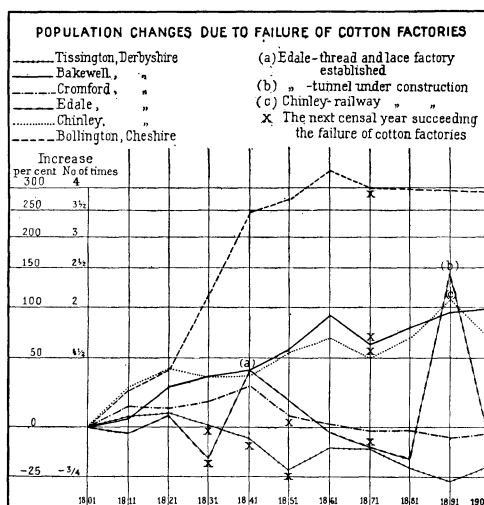


FIG. 15—Population changes due to failure of cotton factories.

During the early years of water power and experimental steam power cotton factories lay somewhat scattered along a line from Manchester past Stockport to Derby and Nottingham. Yet even the factories tended to concentrate; Figure 15 indicates the results of this tendency. Normally the cotton factories caused the population to increase at least fivefold, but in the cases shown in Figure 15 progress was changed to decline when the absence of coal and the difficulties of climate or transport caused the factories to fail. The cotton workers, therefore, are largely concentrated between Stockport and Glossop in the north and between Derby and Nottingham in the south, where maximum concentration of workers gradually occurred. The southern area is unsuited by climate for variety of cotton goods and specializes in hosiery and lace and contains 30 per cent and 70 per cent of Britain's makers in these commodities respectively. By inertia some cotton factories still linger in the Derwent Valley, but an owner remarks that he can only spin the coarser counts of cotton thread by surrounding his factory with canals, so great is his climatic disadvantage. The Stockport district strictly belongs to the cotton district of southeastern Lancashire; its relative importance may be gaged from the fact that it contains but 8 per cent of Britain's workers in cotton, while in the immedi-

ate district beyond the Mersey the cotton operatives are almost ten times as numerous. Striking evidence of the effect of cotton on the population is afforded by Figures 16 and 17, which are maps of Longdendale and its neighborhood. Figure 16 is based upon Doctor Aikin's map (about 1795), and Figure 17 is based upon a modern map made a century later. Doctor

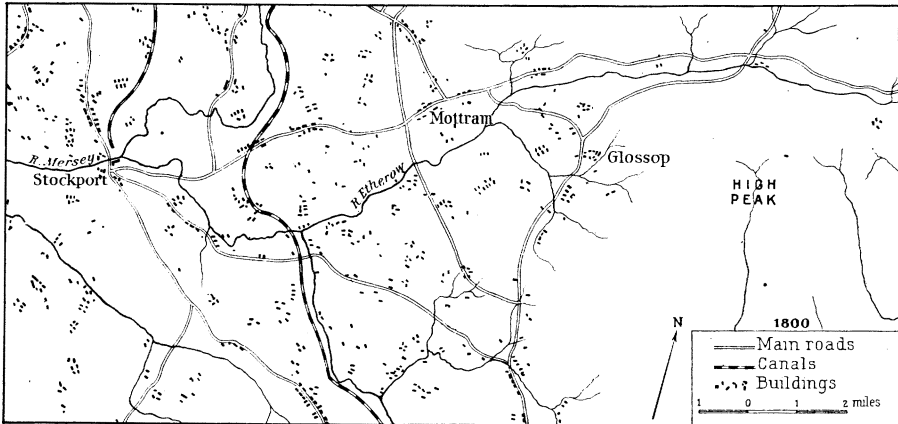


FIG. 16—Stockport and Longdendale about 1800 A.D.

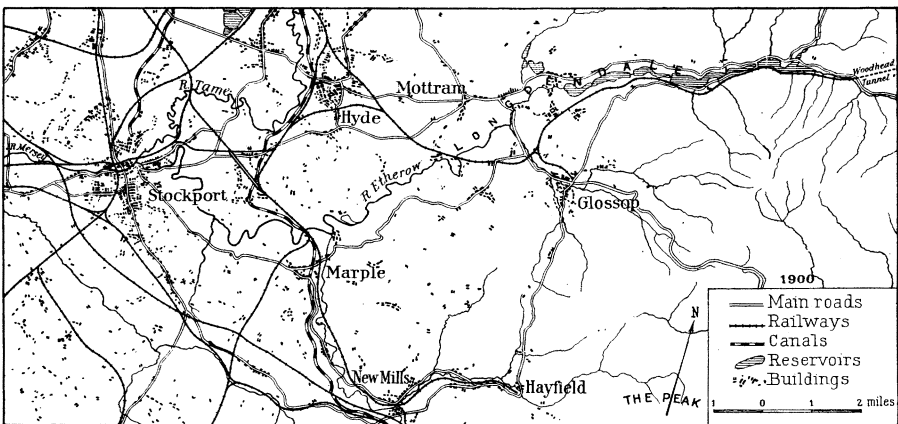


FIG. 17—Stockport and Longdendale about 1900 A.D.

Aikin's map is, on the whole, an excellent piece of cartography; the rivers are well drawn. The main rivers and canals have scarcely altered during the century; the upland still contain few houses. But note the buildings in modern times. Manchester, which is just off the northwest corner, stretches continuously to Stockport and Hyde, and Stockport extends almost in the same way to Marple and New Mills. The new railways form a notable addition to the map. The reservoirs were built to give Manchester an adequate supply of water; they date from about 1850. The

Mersey below Stockport (on the edge of the map) was crossed by ferry until 1850; only since 1877 have adequate bridges been available. The buildings lie along the edge of the coalfield; at Dukinfield, west of Hyde, a pit over 6,000 feet deep was considered in 1880 to be one of the deepest in the world.

The Effect of the Railways. Before 1851 the early railways had formed part of the East and West Coast routes from London to the north; in this respect the iron road had accepted the tradition of the turnpike,—it crossed the area of the Southern Pennines in order to form connections between more important areas both to the north and to the south. During the period of the railway mania in the forties much of the capital subscribed to the numerous schemes came from Manchester and Liverpool, which were desperately anxious to open communications to the south.

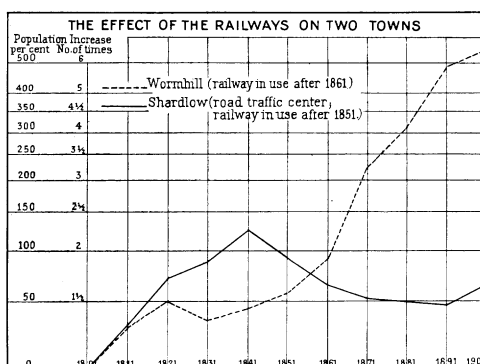


FIG. 18—The effect of the railways on two towns.

Consequently the railways may be regarded as a dynamic factor influencing the population from without. Some direct results of railway construction are to be seen in Figure 18. At Shardlow there had been a large posting station, but when the railways served the nearby town of Derby the people of Shardlow migrated. At Wormhill the convenience of the railway brought inhabitants after 1861. In most other cases the effect of the railways cannot be disentangled from the effect of coal and cotton, so that the influence of the iron road can only be traced in Figure 11 by the examination of the new railways as they were gradually constructed. The main features of the railway connection were determined before 1851, so that the rest of the century was spent in adding connecting links and in duplication of routes; at the same time the existing routes increased the number of tracks from single to double and often to quadruple sets of metals.

The Great Northern Railway connection through Newark and Retford, opened by 1861, brought the great East Coast route to its present track from London through these towns to York and Newcastle and displaced Derby. Cross-connections between Stoke, for example, and Northwich were made in three stages. The eastern colliery district is noteworthy for its numerous railways, which are thoroughly linked together by routes which have been steadily developed since 1851. This progress was uniformly maintained, since during the period 1851-1901 the number of people per mile of railway was steady at approximately 2,000. In 1851 about 14 per cent of the area was more than five miles from a railway line; but by 1901

no land was so far removed from the iron road. About two-fifths of the area was at least two miles from the railway in 1851, and this area was reduced to about one-fifth in 1901.

CONCLUSION

It will be well to summarize the main results of this investigation in a tabular form which necessarily takes notice only of prominent elements in the environment of these people who have lived on the edge of the industrial North and consequently have been affected by the triumphs of machinery and steam and yet have preserved elements of individuality; the cotton workers of Nottingham differ from those of Stockport, and the potters have a different character from the brewers of Burton. Only within the last few years of the nineteenth century is it true to say that the workers of a given industrial area have emerged to any degree from the isolation in which the early days of the industry were necessarily passed.

SUMMARY OF ENVIRONMENTAL INFLUENCES AND THEIR EFFECT ON THE POPULATION

OCCUPATION OF THE PEOPLE	STATIC FACTORS	DYNAMIC FACTORS	EFFECTS ON THE POPULATION
Coal mining.	Coal Measures.	(1) Establishment of factories, iron works, potteries near the coal to satisfy an external demand. (2) Roads, railways, canals, to connect the mining areas with the great trunk routes of England.	(1) Report steady increase at the maximum rate near the old collieries. (2) Sudden enormous increase when new pits were sunk. (3) Migration to coalfields from rest of area.
Cotton working.	(1) Rainfall and humidity. (2) Coal Measures.	(1) External supplies of raw cotton. (2) External demand for cotton goods.	(4) Immigration to coalfields from rest of England.
Pottery working.	(1) Coarse clay. (2) Coal Measures.	(1) External supplies of china clay. (2) Demand for pottery and china.	(5) Scarcity of labor on farms; therefore farms are small.
Salt mining.	Keuper marl.	Roads, canals, railways.	Steady normal increase.
Lead mining.	Mountain limestone.	World changes in sources of supplies of lead.	Decline.
Sheep rearing.	Mountain limestone. Bunter sandstone.	Absence of railway.	Sparse population with slight change.
Mixed farming for milk, oats and potatoes.	Rainfall (the wetter west).	(1) Demand for food supplies from factory towns.	(1) Comparatively dense rural population in west.
Mixed farming for milk, barley, wheat and turnips.	Rainfall (the drier east).	(2) World changes in farming cause (a) decline in wheat acreage; (b) increase in pasture land.	(2) Steady or declining population in general. (3) Migrations from the farms.